RESEARCH

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EXTENSION NOTE #24
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Natural Regeneration in Managed Uneven-aged Douglas-fir Stands in the IDFdk3, IDFxm and IDFxw Biogeoclimatic Subzones

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INTRODUCTION

Uneven-aged drybelt interior Douglas-fir (*Pseudotsuga menziesii* var. *glauca)* stands have been harvested for over 50 years in British Columbia. Within the Cariboo Forest Region, most drybelt Douglas-fir stands are located in the Interior Douglas-fir (IDF) biogeoclimatic zone. Stands have been partially cut at varying intensities. Natural shelterwoods, based on cutting all trees over a fixed diameter, were common through the 1970's to the mid-1980's. This was replaced by the single tree selection silvicultural system to improve the quality of the residual stand, decrease logging damage and improve regeneration establishment on dry sites after harvest.

Despite the number of years in which drybelt uneven-aged Douglas-fir stands have been harvested, very little information is available on post-harvest natural regeneration success and stand basal area growth rates.

In 1995, a retrospective study was initiated to increase understanding of how past harvesting practices have effected natural regeneration establishment and growth within uneven-aged Douglas-fir stands. Stands were selected in three subzones: IDFdk3, IDFxm and IDFxw. All 31 stands in the study were partially cut between 1980 and 1987, but not spaced. This extension note summarizes the results from two unpublished reports (Catton 1997; Day 1996). For clarification, the authors define **Stocking** as a measure of site occupancy and is described by basal area, and **Density** as a measure of spacing, or competition and is described by stems/ha.

STUDY OBJECTIVES

The study objectives were to:

1. evaluate natural regeneration success in partially cut uneven-aged Douglas-fir stands,
2. determine if the stands r[illegible]sity criteria specified in the [illegible]*ted Guidelines for Manage[illegible]ent of Uneven-aged Drybelt Douglas-fir stands in British Columbia - First Approximation* (B.C. Min. of For. 1992),
3. determine post harvest basal area growth (m^2/ha/10yrs) and
4. determine if uneven-aged stand structure was maintained with harvesting.

RESULTS AND DISCUSSION

The main results of this study are presented in Table 1. Natural regeneration was abundant within all the sample blocks. Of the 31 blocks, 28 met

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the well-spaced, density standards (B.C. Min. of For. 1992). In 1995, ten blocks exceeded the maximum density of 2,000 stems/ha in Layer 3 (B.C. Ministry of Forests and B.C. Environment 1995) and should be considered for spacing. Furthermore, when the high densities of post-harvest natural regeneration (Layer 4) are considered, the majority of blocks may have to be spaced within the next ten years.

The leader growth in Layer 3 was greater than 10 cm/yr in the IDFdk and IDFxm but half that rate in the IDFxw. This very dry subzone may be more sensitive to overstocking. Growth of Layer 4 trees was low in all three subzones. Juvenile spacing of Layer 3 is required to improve growth in Layer 4. The most frequent condition code for trees in Layers 3 and 4 was fair, indicating moderate form and vigor.

Harvesting removed from 13 to 89% of the pre-harvest basal area of each block. The remaining basal area ranged from 3-33 m^2/ha. Post-harvest basal area growth ranged from 1.7 to 8.3 m^2/ha/10 yrs. The wide range in growth is attributed to:
1) pre-harvest stand structure, intensity of partial cutting and type of silvicultural system prescribed and,
2) for some blocks, the small amount of radial growth data which limited the accuracy of the predicted basal area growth.

Of the six blocks that were lightly cut (13-30% basal area removal), five have recouped basal area close to pre-harvest levels. However, most of this has grown on small trees (<15cm dbh), therefore, the cutting cycle will be delayed until more trees reach merchantable size. The majority of the blocks sampled did not maintain pre-harvest stand structure. This was particularly evident for diameter limit cut blocks (natural shelterwood). Stands with a lower basal area removed and increased maximum diameter retention appear to maintain stand structure.

Variable	Subzone		
	IDFdk3	IDFxm	IDFxw
# of blocks	14	8	9
Pre-harvest basal area (mean - m^2/ha)	31.4	27.9	19.0
Post-harvest basal area (mean - m^2/ha)	16.6	12.6	10.5
Percentage of basal area removed (range - m^2/ha)	14-75	17-89	13-75
Post-harvest basal area growth (mean - m^2/ha/10yrs)	5.0	3.5	3.7
Post-harvest basal area growth (range - m^2/ha/10yrs)	2.7-8.3	1.9-6.2	1.7-7.2
Number of SR blocks (well spaced stocking standards)	14	6	8
Well spaced stems/ha (mean)	1089	853	947
Stems/ha - Layer 3 (mean)	2003	1170	2047
Stems/ha - Layers 3 & 4 (mean)	5852	4469	4840
Leader growth - Layer 3	11.0 ±	15.4 ±	6.1 ±
Fir (mean & SD- cm/yr)	5.3	10.8	7.0
Leader growth - Layer 4	3.8 ±	3.7 ±	2.7 ±
Fir (mean & SD- cm/yr)	2.0	2.7	2.2

Table 1.
Summary of Stocking, density and growth in 3 IDF subzones

CONCLUSIONS

- there is sufficient natural regeneration regardless of harvesting intensity with one exception - steep, southerly slopes with low crown closure.
- juvenile spacing is required to improve growth and maintain density control
- basal area growth needs to accumlate on larger size trees therefore prescriptions have to leave adequate numbers of larger trees on the block by adjusting residual growing stock (B), maximum diameter (D) and quotients of dimunition (q).
- IDF Douglas-fir stands are highly variable in terms of pre-harvest stand structure - therefore prescriptions need to be site specific and carefully applied.

RESEARCH NEEDS

- development of a basal area growth model to help determine cutting cycle length and level of basal area removal. In the short term, a growth model could be created using 10 year increment data, while in the long-term the establishment and/or continued monitoring of permanent growth and yield sample plots is essential.
- determine if regeneration growth can be improved by manipulating stem density in Layer 3, and varying gap size through harvesting to improve exposure to sunlight.
- examine the relationship between stocking and density in Layers 2 - 4 and the degree of bark beetle attack in Layer 1.

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